CHAPTER 11

Protecting Yourself

Getting Ready...

- How does your body protect itself from disease?
- What does your immune system do?
- What vaccinations have you had?
- How might using medicines improperly harm you?

Science Log

Look for an ad about vaccinations and describe it in your Science Log. Consider what point the ad is trying to make. Express your opinion about the ad's effectiveness.

Don't touch the keyboard! There's a chicken pox virus hanging around.

Hold your breath — someone just sneezed!

You have many opportunities to be exposed to disease. Why don't you get sick more often?

The answer is that your body has several lines of defence against disease. In this chapter you will learn about the ways your body protects itself from invaders. You will learn about treatments available for when you *do* get sick. For example, you can prevent tetanus, which is caused by bacteria that enter your body through a cut, by getting a vaccination against it, and then continuing to get booster shots periodically.

Are your vaccinations and booster shots up to date? By the end of this chapter, you might want to check.

Take a look at the mould in the photograph at the top of page 193. Penicillin, which was the first antibiotic developed, comes from this mould, which grows on bread! Today, there are many types of antibiotics. In this chapter you will also learn why you need to use antibiotics properly.

from Disease

What You Will Learn

In this chapter you will learn:

- how your body's physical defences prevent infection
- how your blood helps control pathogens
- how your immune system protects you
- how antibiotics and vaccinations prevent or treat disease
- about the dangers of using antibiotics improperly

Why It Is Important

- You have likely taken antibiotics in order to fight infections. When antibiotics are used incorrectly, the bacteria and viruses in your body become resistant to them and the antibiotics may no longer work. Knowing how this happens will help you use antibiotics so they continue to be effective.

Skills You Will Use

In this chapter you will:

- identify physical defences against infection
- explain the role of blood in controlling pathogens
- describe the body's immune system
- describe how antibiotics and vaccinations prevent or treat disease
- analyze cold remedies

Starting Point ACTIVITY

Your Skin's Role

Most multicellular organisms have an outer covering. Your outer covering, which is your skin, protects you from infection by pathogens. Use apples to find out how this works.

Safety Precautions

- Clean up the work area and wash your hands thoroughly at the end of the activity.

What You Need

1 apple

vegetable peeler

What to Do

1. Get an apple of any size, shape, and ripeness.
2. Completely peel one-half of the apple.
3. Leave the apple on a counter or desk for a day or two.
4. Predict any changes that you expect to occur.
5. After a day or two, peel the skin from the rest of the apple and compare the freshly peeled part to the part that was already peeled.
6. Observe and record the differences in colour and texture between the two parts of the apple. Use a chart to help you.

What Did You Discover?

1. **(a)** What happened to the surface of the apple after it was peeled?
   (b) What do you think accounts for the differences between the two halves of the apple once it is completely peeled?
2. How is the role of apple skin similar to the role of your skin?
3. Use what you have learned to explain why you should take care of cuts and scrapes.

11.1 Defences against Pathogens

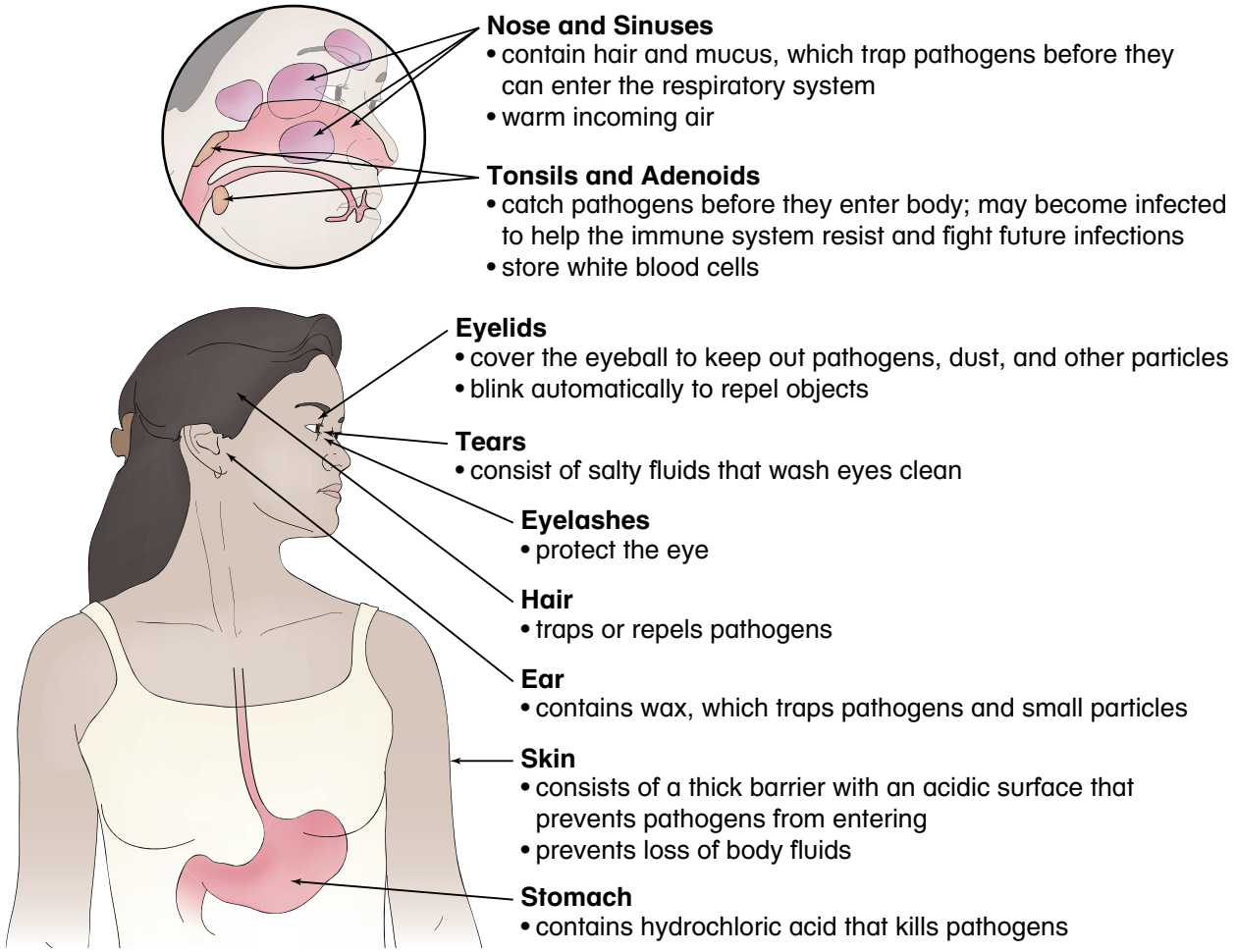
READING Check

List the body's physical defences against disease.

Millions of potentially harmful pathogens surround you every day. They live on your body and on most surfaces you touch. So why aren't you sick all the time? It is because your body has three lines of defence against pathogens: physical defences, the inflammatory response, and the action of antibodies. Antibodies are released by white blood cells in order to destroy pathogens that have invaded the body.

Figure 11.1 shows you the **physical defences**. This first line of defence involves body structures such as the skin and secretions such as mucus. Each of these forms a physical barrier against pathogens. Read the labels with Figure 11.1 to learn how your body's physical defences work and where they are located.

Figure 11.1 Physical defences


Nose and Sinuses
• contain hair and mucus, which trap pathogens before they can enter the respiratory system
• warm incoming air
Tonsils and Adenoids
• catch pathogens before they enter body; may become infected to help the immune system resist and fight future infections
• store white blood cells
Eyelids
• cover the eyeball to keep out pathogens, dust, and other particles
• blink automatically to repel objects
Tears
• consist of salty fluids that wash eyes clean
Eyelashes
• protect the eye
Hair
• traps or repels pathogens
Ear
• contains wax, which traps pathogens and small particles
Skin
• consists of a thick barrier with an acidic surface that prevents pathogens from entering
• prevents loss of body fluids
Stomach
• contains hydrochloric acid that kills pathogens

DidYouKnow?

Cigarette smoke can disable the tiny, hair-like projections called cilia that line the air passages and trap pathogens. Without cilia, more pathogens reach the lungs. The nagging cough that smokers get is the only way for the lungs to remove debris from toxins in cigarettes.

The Inflammatory Response

Have you ever got a sliver — and soon afterward noticed an inflammation around the area? This is an example of an **inflammatory response**. During an inflammatory response, the blood vessels surrounding the injury swell. The area becomes red and warm as more blood arrives.

The body has several inflammatory responses.

- If pathogens get past the physical barrier created by the skin, the body sends white blood cells, that are apart of the immune system, to repel the invader. Study Figure 11.2 and read the caption to see how this works.
- An inflammatory response can also occur when the skin is hit, for instance, when you fall and hit the ground. This response is caused because blood oozes from the ruptured blood vessels into surrounding tissue. White blood cells engulf damaged cells and cell parts at the site of the bruise in order to clean up and heal the bruised area.
- Any kind of infection (e.g. tonsillitis or appendicitis) will trigger an inflammatory response. The 'itis' ending of these words means "inflammation of."

Physical defences and the inflammatory responses are called general defences because the body reacts in the same way regardless of what kind of pathogen is invading. For example, you will blink when something enters your eye. This happens both when it is something you want there, such as a contact lens, or something damaging, such as dust.

The third line of defence is the formation of antibodies in the **immune system**. This line of defence targets specific pathogens and will be discussed in detail in the next section of this chapter.

Try This!

Macrophages destroy pathogens by engulfing them, which is similar to the way amoebae surround and overwhelm their food. To observe this, make a wet mount slide of an amoeba. (Do not use a cover slip.) Use low power to focus on the amoeba and observe how it moves. Place a drop of food on the slide. Observe what happens. To do this, you may wish to change to medium and then to high power. Record your observations.

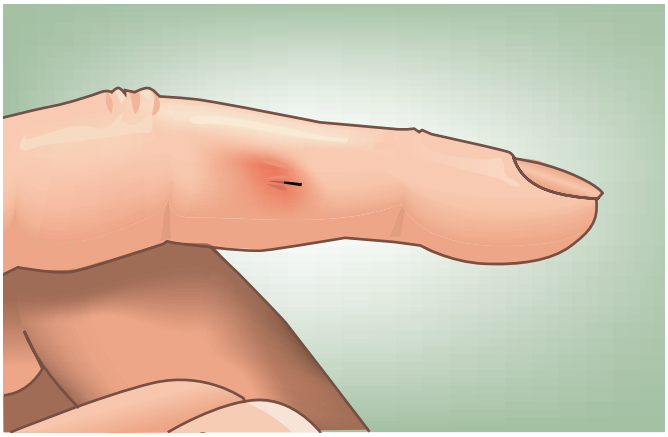


Figure 11.2 The blood vessels surrounding this splinter swell. The area becomes red and warm as more blood arrives. Specialized white blood cells called **macrophages** surround and destroy damaged cells and pathogens such as viruses and bacteria. Macrophages engulf the splinter and start destroying it.

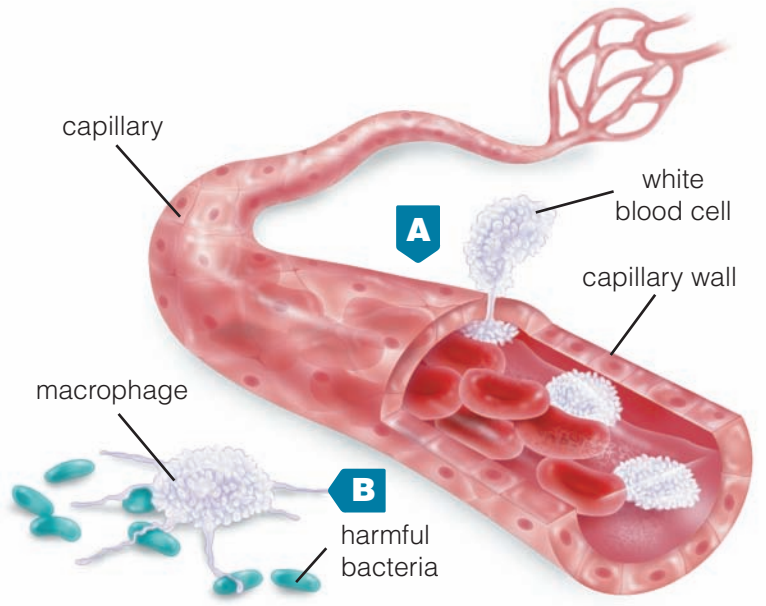


Figure 11.3 Look at how macrophages engulf invading cells. White blood cells leave capillaries (A) and engulf harmful bacteria (B). Macrophages can consume large numbers of pathogens at once.

READING Check

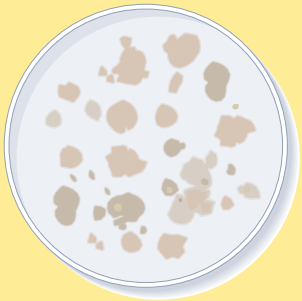
Describe the role that white blood cells play in controlling pathogens.

Find Out ACTIVITY

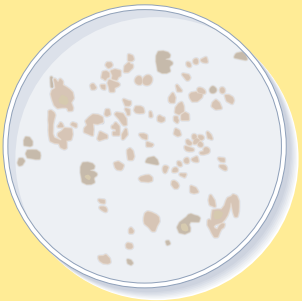
Comparing Bacterial Growth

This is a photograph of impetigo, a skin disease caused by bacteria.

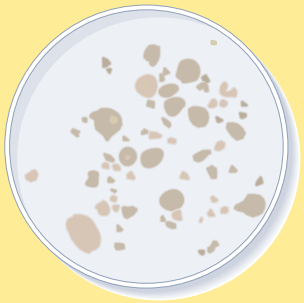
Bacteria are always on your skin, even after you shower! This photograph shows you what bacteria living on skin look like. Find out where bacteria grow best on your body.



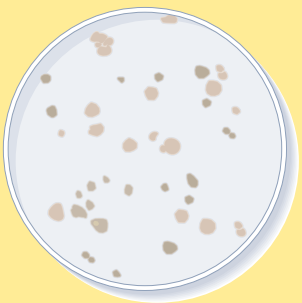
A unwashed finger



B hair



C face



D cleaned finger

SKILL CHECK

- Initiating and Planning
- Performing and Recording
- Analyzing and Interpreting
- Communication and Teamwork

What to Do

1. Study the agar plates. Each one represents the growth of bacteria taken from a body area and grown for three days in an incubator.

What Did You Find Out?

1. **(a)** Which area of the body produced the most bacterial growth?
   (b) Which area produced the least amount of bacterial growth?
2. From your results, what factors might promote or discourage growth in bacteria?
3. Most bacteria are harmless. They compete with each other for living space on your skin. What might happen if someone were too clean?
4. In a group, discuss the following statement as it relates to bacterial growth: The most effective way to prevent the spread of disease is to wash your hands frequently before eating and after using the toilet.

Key Terms

- antibodies
- physical defences
- inflammatory response
- immune system
- macrophages

Check Your Understanding

1. Identify the body's three lines of defence against disease.
2. Develop a short oral description of four physical defences that your body might use to avoid getting a cold.
3. **(a)** What are macrophages?
   (b) What role do they play in defending the body?
4. Since many body surfaces are warm, moist, and contain potential nutrients for bacteria, what might be your best defence strategy against pathogens?

11.2 Immunity

Have you or someone you know ever had the chicken pox? Few of your friends may have had this disease, since there is now a vaccination for it. However, even if you have not been vaccinated, if you have already had the disease, you are unlikely to get it again. This is because you have built up immunity — or resistance — to chicken pox. If you were exposed to the virus again, your immune system would recognize and resist it.

Your body recognizes substances called **antigens** that are not part of itself. Antigens are specifically shaped structures that are attached to pathogens. All living tissues such as viruses, bacteria, and fungi contain antigens. So do pollen, transfused blood, transplanted organs, and cancer cells.

How does your immune system respond to the antigens it encounters? Most of this is done at the cellular level by white blood cells. White blood cells make and release Y-shaped protein compounds called **antibodies**. Antibodies bind to specific antigens. This makes it easier for white blood cells to destroy them.

- When you first contacted the chicken pox virus, your body did not have antibodies against the chicken pox antigen. It immediately started producing them.
- Once your body does have antibodies to a pathogen such as chicken pox, your immune system recognizes and destroys the antigen whenever it shows up again. This is why you are considered to be immune to the disease.

Figure 11.4 explains how antibodies combine with antigens.

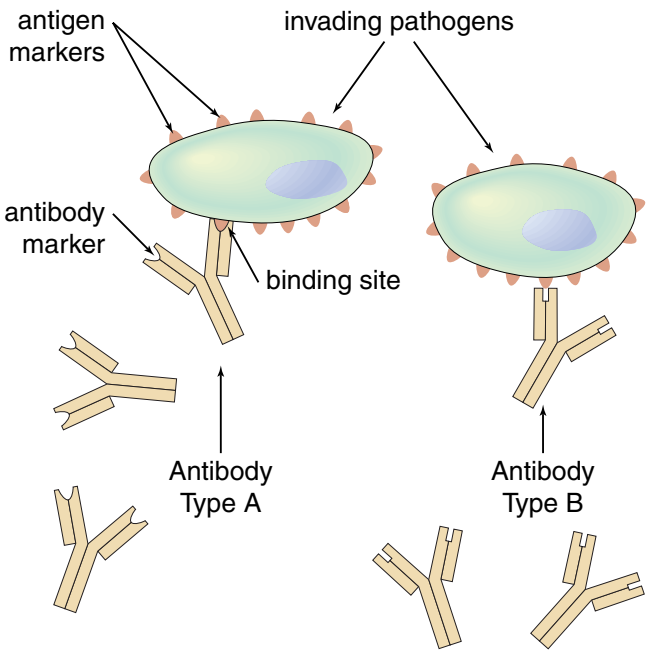


Figure 11.4 Each antibody has a shape that matches a specific antigen. This means that an antibody produced against a cold virus, for example, would not fit with an HIV antigen.

- Antibody Type A attaches one type of antigen with a complementary shape, like a lock and key. For example, a flu antibody would combine with flu antigens.
- Antibody Type B does not combine with the antigen because their shapes do not match. Notice the outer edge of each arm of the antibody and the antigen. The antibody markers are different from those found on the antigen.

DidYouKnow?

The average person has more than 100 000 antibodies waiting for the invasion of antigens.

READING Check

Describe how antigens and antibodies interact.

DidYouKnow?

The immune system produces antibodies against the antigens in transplanted organs.

Such patients are given anti-rejection drugs to prevent their bodies from rejecting the transplant. Unfortunately, the medication shuts down the immune system, which makes these patients less resistant to pathogens.

Immune System on Alert

READING Check

Explain what B cells and helper T cells do.

The body has physical defences to prevent pathogens from entering. There is also an inflammation response to kill pathogens before they do damage. Look at Figure 11.5 to see how the immune system responds when a pathogen gets past these defences, or when it assists an inflammatory response to a pathogen entering the body.

1. When bacteria enter the body, an inflammatory response occurs. Macrophages surround and destroy some of the bacteria.
2. Antigens from the dead bacteria protrude from the macrophages that engulfed the bacteria.
3. White blood cells called helper T cells identify the antigens on the macrophages. White blood cells called B cells make and release antibodies.
4. The antibodies produced by the B cells attach to antigens and destroy them.
5. B cells produce memory cells that store information about the antigen of the invader, making it easier to destroy.

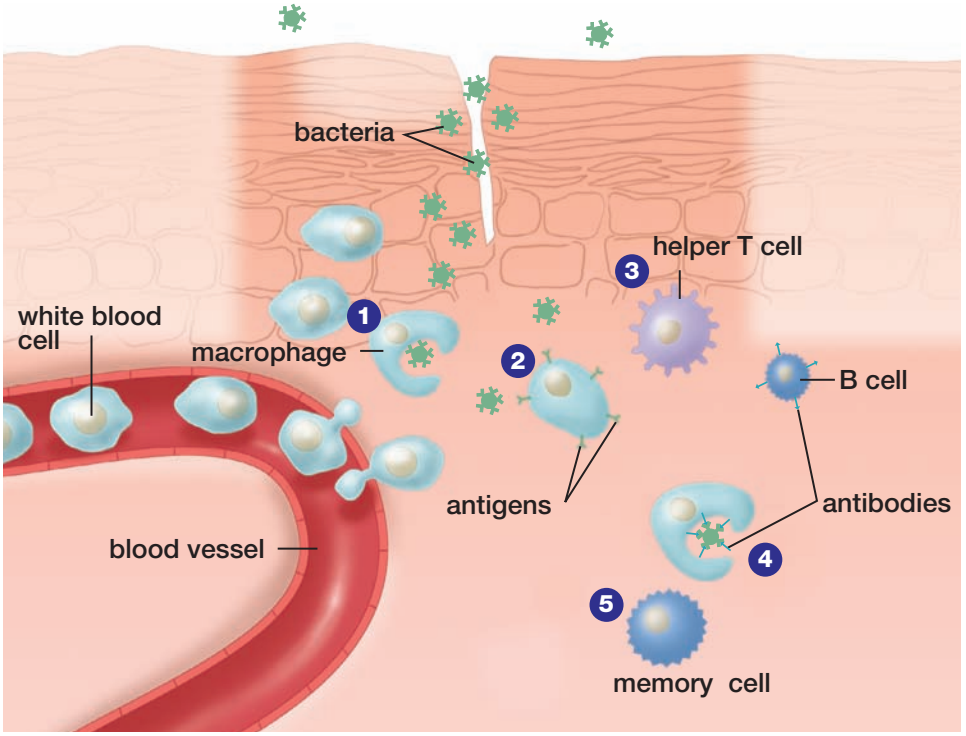


Figure 11.5 How your body responds to antigens

Find Out ACTIVITY

SKILL CHECK
- Initiating and Planning
- Performing and Recording
- Analyzing and Interpreting
- Communication and Teamwork

Detecting Infection

Compare red blood cells and white blood cells. Remember that white blood cells fight infection and red blood cells carry oxygen to your body tissues.

What You Need

compound microscope

prepared slide of human blood

What to Do

1. Get a slide of human blood.
2. Use the microscope to view the slide under high power.
3. Identify the red blood cells and the white blood cells.
4. Divide your field of view into quarters. Count the number of red blood cells and white blood cells in one quarter. Record your count.
5. Multiplt the count by four to calculate the total number of cells in the field of view.
6. Move the slide to two different positions. Each time count and record the red blood cells and the white blood cells.
7. Total the number of red blood cells and white blood cells. Calculate the percentage of the blood cells that are white.
8. Do the analysis provided by your teacher.

Types of Immunity

You are born with a certain amount of immunity. This is called **inherited immunity**. Inherited immunity refers to the resistance that organisms have to most diseases. This form of resistance is passed on genetically.

From birth on, you build what is called **acquired immunity**. Figure 11.6 shows that acquired immunity is divided into two types according to how you get it.

- Your body develops **active immunity** by making antibodies against diseases to which you have been exposed. This is the type of immunity you might develop against chicken pox.
- You acquire **passive immunity** from antibodies produced in another animal and put in your body. This is the kind of immunity you might get against tetanus when you get a tetanus vaccination.

READING Check

Explain the different ways that people can develop or acquire immunity. Give an example of each.

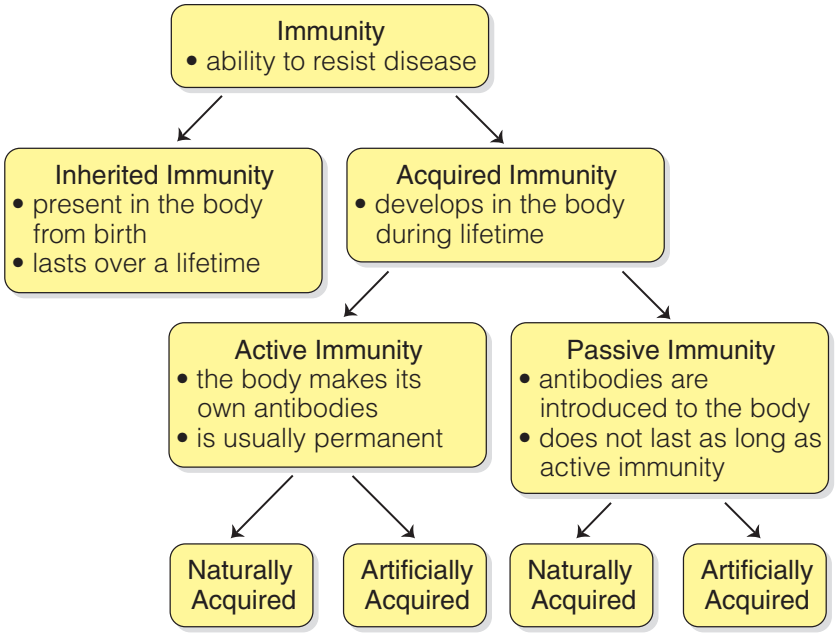

Immunity
• ability to resist disease
Inherited Immunity
• present in the body from birth
• lasts over a lifetime
Acquired Immunity
• develops in the body during lifetime
Active Immunity
• the body makes its own antibodies
• is usually permanent
Passive Immunity
• antibodies are introduced to the body
• does not last as long as active immunity
Naturally Acquired
Artificially Acquired
Naturally Acquired
Artificially Acquired

Figure 11.6

Disc CONNECT

To learn more about immunity, load the student CD-ROM onto your computer. Launch the **Immunity** applet and follow the instructions.

A. Naturally Acquired Active Immunity "Strawberry tongue" is often a symptom of scarlet fever. Once you have had scarlet fever, you are unlikely to get it again. That is because your body builds immunity against the disease.

B. Artificially Acquired Active Immunity Hepatitis B vaccine works well against hepatitis in teens. This provides artificial immunity. The hepatitis virus is cultivated by infecting yeast cells.

C. Naturally Acquired Passive Immunity As long as babies continue to breast-feed, they are immune to many of the same diseases as their mother.

D. Artificially Acquired Passive Immunity Small amounts of snake venom are injected into animals such as cows or horses to create antibodies. The antibodies are called antitoxins. The antitoxin is removed from the animal's blood and used to provide immunity in people who are bitten by that type of poisonous snake.

CONDUCT AN

INVESTIGATION 11-A

SKILL CHECK

- Initiating and Planning
- Performing and Recording
- Analyzing and Interpreting
- Communication and Teamwork

Blood Transfusions

Do you know which blood type you are?

There are four blood types: A, B, AB, and O. Doctors check patients' blood type before giving a transfusion. That is because the blood type of the transfusion must match the blood type of the person who gets it.

Blood types must match because there are two kinds of antigens on the red blood cells of humans and two kinds of antibodies in the plasma. If the blood types do not match, antigens will react with antibodies, causing blood cells to clump. The clumps can lead to heart attacks and strokes.

In this investigation you will simulate what happens when blood types are mixed together.

Problem

What happens when blood types are mixed?

Safety Precautions

- Do *not* use actual blood.
- Clean up the work area and wash your hands thoroughly at the end of the investigation.

Apparatus

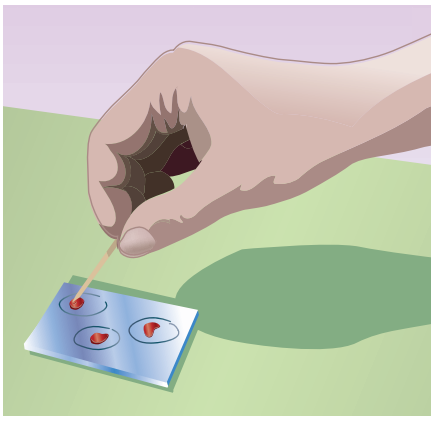
4 blood plates

Materials

simulated Type A blood
simulated Type B blood
simulated Type AB blood
simulated Type O blood
toothpicks
simulated A antibodies
simulated B antibodies

Procedure

1. Choose a partner and obtain a blood test plate.
2. Use a toothpick to add a drop of type A blood inside each of three circles on the blood plate.
3. Use a toothpick to add a drop of A antibodies to the blood inside one circle. Add a drop of B antibodies to another circle. Remember to use a new toothpick each time. Use the third circle as a control.



4. Record your observations.
5. Repeat Steps 1–4 for Type B, Type AB, and Type O blood.

Analyze

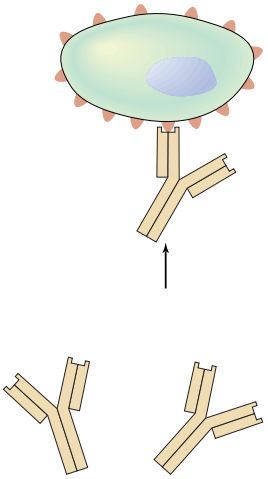
1. What happened when you mixed each of the following blood types and antibodies?
   - **(a)** Type A blood and B antibodies
   - **(b)** Type A blood and A antibodies
   - **(c)** Type B blood and A antibodies
   - **(d)** Type B blood and B antibodies
   - **(e)** Type AB blood and A and B antibodies
   - **(f)** Type O blood and A and B antibodies

Conclude and Apply

2. From your observations, why does mixing blood types during a transfusion have serious consequences?
3. From your observations, why do you think Type O is often called the universal donor?

Check Your Understanding

1. Use this sketch to explain how antibodies are specific.
2. Macrophages, helper T cells, B cells, and killer T cells are all part of the immune system. Make a sketch or develop a table to help explain what part each one plays.
3. Explain the difference between active and passive immunity. Provide two examples of each.



Key Terms

antigens
inherited immunity
acquired immunity
active immunity
passive immunity

11.3 Immunization

Why do some people get a flu shot each year?

They know that their body can develop immunity by getting either an injection of **vaccine** or an injection of antitoxin.

- A vaccine consists of weakened or dead disease pathogens. Once a vaccination or **immunization** is inside your body, your body begins to produce antibodies against the antigens in the vaccine. The disease is weaker than usual because of the weakened or dead pathogens. As a result, you get few or no symptoms. After your body produces antibodies, you have lasting protection against the real disease.
- The injections you get for tetanus and diphtheria contain antitoxins drawn from animal blood. Antitoxins neutralize the effect of toxins and act faster than vaccines.

Internet CONNECT

www.mcgrawhill.ca/links/science.connect2

In 1796, a British doctor called Edward Jenner gave the first-ever vaccination for smallpox. He noticed that dairy farm women who suffered from cowpox, a mild disease affecting cattle, were immune to smallpox. Find out how Dr. Jenner used cowpox to make a vaccine by going to the above web site. Then go to Internet Connects, Unit C, Chapter 11, and then to Edward Jenner.

READING Check

How do vaccines work?

See Table 11.1 for the list of preventable diseases most Canadians are immunized against, and the effects of each disease.

Disease	Effects of Disease
diphtheria	• infection in nose and throat can make breathing difficult • skin infections, rapid pulse • heart failure, paralysis, death
measles	• red rash, high fever, cough, sore throat • often ear infections and pneumonia
mumps	• painful, swollen salivary glands; fever; headache
polio	• fever, headache, stiff neck and back, muscle weakness • often permanent paralysis, death
rubella	• mild fever, rash, swelling of the neck • dangerous during early pregnancy; causes miscarriages and handicaps
tetanus	• muscle spasms, difficulties breathing • death
whooping cough	• severe coughing, difficulties breathing • often pneumonia • sometimes brain damage and death

Table 11.1 Preventable Diseases
You were born with all of your mother's antibodies. These antibodies lasted a short time, longer if you were breastfed. Childhood vaccinations allow you to continue having the benefits of this immunity.

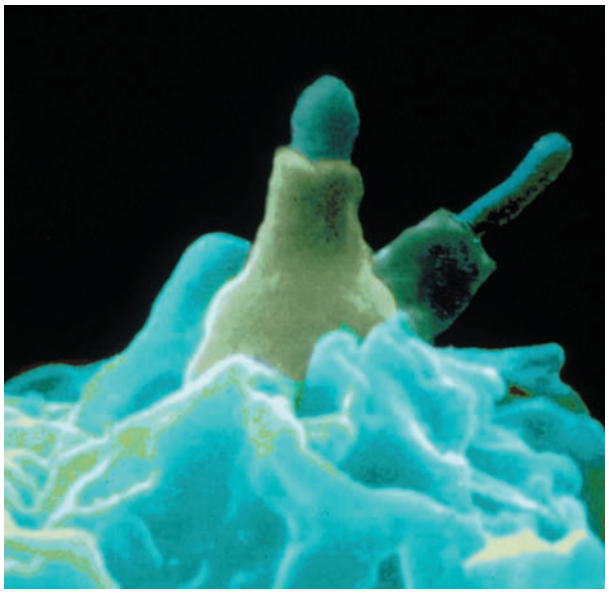


Figure 11.7 This photo shows a cell infected by the polio virus. The shot is magnified 9000x. There is no cure for polio. In the 1950s, Jonas Salk introduced a vaccine to prevent polio. His team of researchers found a way to manufacture enough polio virus to make vaccines. They discovered that the polio virus grew on scraps of tissue treated to prevent bacterial growth. The research team won the 1954 Nobel Prize in medicine for this discovery!

Why Get Immunization Shots?

Some people do not get immunized for personal or medical reasons. For example, some people react to certain immunizations. Such reactions often occur in people whose immune systems have been weakened by a disease such as asthma or by severe allergies. In such people, whooping cough vaccine can occasionally cause reactions such as high fevers or seizures.

If vaccinations can cause such reactions, why do most people get them?

Basically, immunizations prevent more problems than they create. Immunizations have reduced the incidence of communicable diseases and the number of deaths from them. Worldwide immunization against smallpox, for example, has actually eliminated that disease.

Recently, some countries have stopped or limited immunization programs. As a result, there have been increases in diseases, such as polio, that had almost disappeared.

READING Check

Why should you get immunizations?

READING Check

Explain how an immune response can cause an allergy.

Allergies

Allergies develop when the immune system overreacts and becomes sensitive to substances such as pollen, dust, or mould. The immune system then treats the substance as though it were a pathogen and begins to build antibodies against it. These antibodies result in a variety of symptoms. Mild reactions include a runny nose and itchy or watery eyes. Severe symptoms can include breathing difficulties, and can build to extreme allergic reactions that cause death.

Scratch tests identify allergens. Drops of antigen are absorbed under the scratched skin. Allergic reactions produce redness, swelling, and itching along the scratch.

People who suffer from allergies sometimes get immunotherapy. This involves injections of weakened allergens. Regular injections build the number of antibodies against the allergen.

DidYouKnow?

Beware of the rabies virus from the bite of infected animals such as dogs and wild animals. Rabies is nearly always fatal if left untreated. Treatment requires a series of injections of antibodies and vaccines. Researchers are working on an improved vaccine.

Internet CONNECT

www.mcgrawhill.ca/links/science.connect2

Read the comics to find out more about Jonas Salk and polio by going to the above web site. Then go to Internet Connects, Unit C, Chapter 11, and then to Jonas Salk.

Find Out ACTIVITY

Allergies

How widespread are allergies? You will find out during this activity.

SKILL CHECK

- Initiating and Planning
- Performing and Recording
- Analyzing and Interpreting
- Communication and Teamwork

What to Do

1. In a group, survey the people in your class to gather the following information about allergies.
   - kinds of allergies people have
   - time of year when the allergies are a problem
   - symptoms
   - treatments
2. Use reference books or the Internet to answer the following questions about each allergy you identified in the survey.
   - How common is the allergy?
   - What are the symptoms?
   - What is the treatment?
   - Are people born with the allergy, or does it develop?
3. Organize your findings in a chart.

What Did You Find Out?

1. Develop a short oral presentation about the three most common allergies in your class.
2. Are certain times of the year worse than others for allergy sufferers?
3. Are people born with allergies or do they develop allergies?

Computer CONNECT

Use a word processor to make charts to organize your information.

Check Your Understanding

Key Terms

vaccine
immunization

1. How do vaccines prevent disease?
2. List at least five diseases most infants and children should be immunized against.
3. What might happen in a community where children were not immunized for whooping cough?
4. Do the Internet Connect on either page 201 or 202. In your own words, describe one of the following:
   - how Edward Jenner developed a smallpox vaccine; or
   - how Jonas Salk developed a polio vaccine.

   How does the vaccine you chose prevent people from getting the disease? Present your response orally.

11.4 Treating Infectious Diseases

READING Check

How can you decide between using an antibiotic or an over-the-counter drug?

No vaccine has yet been developed that can prevent colds! That's because the cold virus keeps mutating. As fast as someone tries to develop a vaccine for the common cold, a new cold virus appears. When you get a cold, your body is usually able to heal itself within about a week. There are times, however, when your body needs help.

Usually, people try **over-the-counter drugs** to relieve or treat symptoms. Over-the-counter drugs are sold without a doctor's prescription. They relieve symptoms such as fevers and headaches that accompany colds, but do not kill the viruses that cause the cold.

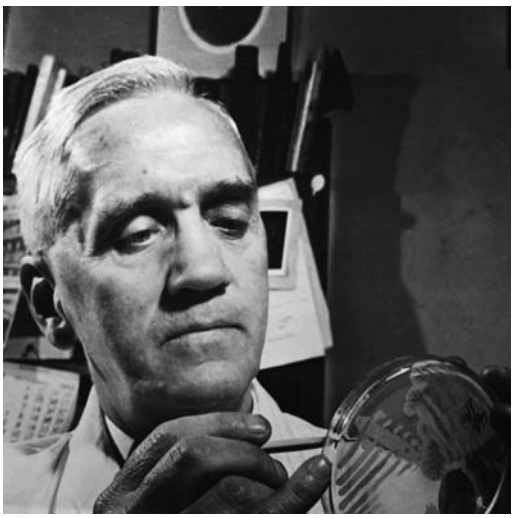


Figure 11.8 A blue mould called *penicillium notatum* became famous after Sir Alexander Fleming of Scotland discovered it by accident in 1929. He noticed some mould colonies growing in a dish of bacteria he was studying. No bacteria were growing around each mould colony. Fleming concluded that the mould produced a substance that killed the bacteria. His work led to the discovery of penicillin — the first antibiotic. Today scientists develop antibiotics from fungi, moulds, and bacteria.

If symptoms of infection continue, your doctor may prescribe an **antibiotic**. Antibiotics fight bacterial infections by either killing bacteria or preventing them from reproducing. Each antibiotic is effective against specific types of bacteria. They do not, however, help with a viral infection.

When treating a cold or strep throat, you need to know whether or not the infection is bacterial or viral. Viruses cause colds, the flu, most sore throats, coughs, and sinus infections. Since antibiotics do not work against viruses, the best thing you can do for these is to drink plenty of fluids, get rest, and perhaps take over-the-counter drugs to relieve any symptoms. Since bacteria cause strep throat and pneumonia, an antibiotic might be effective in treating these.

Figure 11.9 Scientists test antibiotics by growing bacterial colonies and introducing small disks of antibiotics to the bacteria. You can see the mould is killing some bacteria. Scientists determine the effectiveness of antibiotics by measuring the size of the "no-growth" zone.

DidYouKnow?

Aspirin™ has existed since 1899! Overuse can cause stomach irritation and interfere with blood clotting. Children under 16 should not take the drug after a viral infection because Aspirin™ is linked to Reyes syndrome, a rare disease that affects the blood, liver, and brain.

DidYouKnow?

AIDS is the fastest growing disease worldwide. There is no cure for AIDS yet. People with AIDS have too few helper T cells to carry out the immune function. As a result, they are susceptible to many infections that would otherwise be easily controlled.

Problems with Antibiotics

Some people demand antibiotics to fight every cold and sore throat they have. This is not a good idea for the following reasons:

- **They kill harmful and helpful bacteria** — Your body contains many helpful bacteria that aid in such things as digestion. Antibiotics kill these, and can cause symptoms such as an upset stomach, diarrhea, or vaginal yeast infection.
- **They can cause side effects** — Some people develop allergies to antibiotics. Report any symptoms, such as an itchy rash, to your doctor.
- **Overuse can help the development of resistant bacteria** — Figure 11.10 shows how bacteria can build resistance against an antibiotic. Study this figure and the accompanying caption.

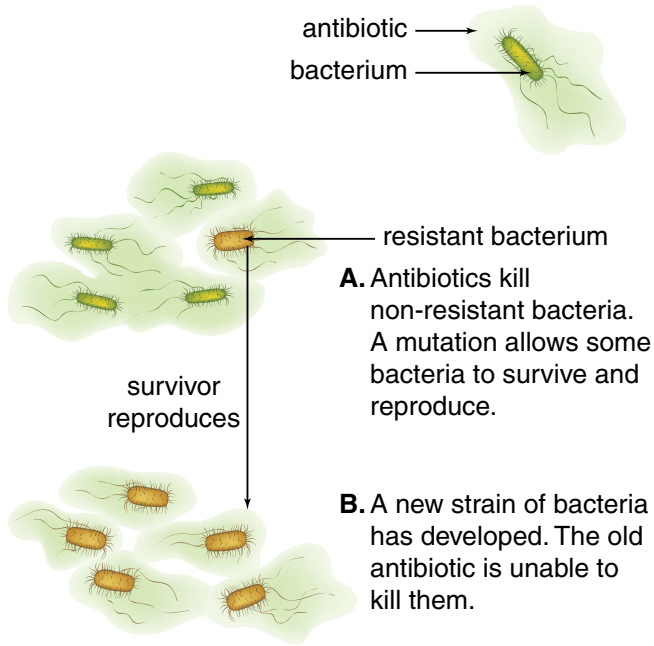

antibiotic
bacterium
resistant bacterium
A. Antibiotics kill non-resistant bacteria. A mutation allows some bacteria to survive and reproduce.
survivor reproduces
B. A new strain of bacteria has developed. The old antibiotic is unable to kill them.

Figure 11.10 When you take an antibiotic, it usually kills bacteria over a period of seven to 10 days. Regularly occurring mutations mean that some of the bacteria are immune to the antibiotic. These bacteria survive and reproduce, forming a new antibiotic-resistant strain of infection. Not taking all of the antibiotic the doctor prescribes can increase the chance of bacteria becoming resistant.

The resistant bacteria are often called superbugs. When the superbugs reproduce, the new strain of the disease begins to infect many people. People die from infections that used to be treatable because the new superbugs are resistant to one — or sometimes many — antibiotics.

Even if you are a healthy person who has never taken an antibiotic, you could become infected with a superbug from other people. That is why bacterial resistance poses such a threat. The best way you can help avoid this is by using antibiotics only when necessary and following the doctor's directions for their use.

Disc CONNECT

If you have not already used the **Bacteria** applet, load the student CD-ROM onto your computer. Launch the **Bacteria** applet to learn more about overuse of anitbiotics.

DidYouKnow?

Sweat, tears, and saliva contain an enzyme called lysozyme. Lysozyme helps destroy some pathogens by working like a natural antibiotic.

READING Check

Explain how resistant bacteria develop and what you can do to help.

DidYouKnow?

Drug reactions account for one in five hospital admissions. Nine out of 10 patients do not take medicines properly. For example, combining medicines may produce effects different from those produced when a medicine is taken alone, or it may produce side effects.

Use Antibiotics Safely

- Ask questions — Ask your doctor or pharmacist about precautions to take when using a medicine, and about any side effects. Before you take two or more medicines at the same time, ask if they can be taken together safely.
- Read the label — Find out how and when to take medicine. Some medicines must be taken with food; others on an empty stomach. Some medicines cause sensitivity to the Sun. Also check the expiration date and discard any medication that has passed the expiry date.
- Take drugs properly — Follow the directions on the label until you have taken all of the medication. Not doing so may lead to the development of antibiotic-resistant bacteria.

READING Check

What precautions should you take when using an over-the-counter drug to treat specific symptoms? What precautions should you take when using an antibiotic for any reason?

Handling Over-the-Counter Drugs

In most cases, over-the-counter drugs are considered safe to use. However, there are risks if you treat yourself without professional advice.

Generally, you should not assume that you have a specific disease and choose a medication to treat it. The same symptom can result from one of several diseases, and you may be treating the wrong ailment. For this reason, avoid self-diagnosis unless you are dealing with a problem you have had before and have exactly the same symptoms.

Figure 11.11 Many different diseases have the same symptoms. For this reason, it is best to check with a doctor or pharmacist before buying an over-the-counter drug.

Choosing Over-the-Counter Drugs

When you have a choice among several medications, read the labels carefully.

- Find out what symptoms the medicine treats. If you have a headache, look for something that relieves headaches.
- Read the warnings and list of side effects. Many medications make you drowsy. If you must take one of these, you may need to ask a friend to drive or postpone a date.
- Use exactly the amount of medication prescribed, and use it for the recommended length of time.

READING Check

What information should you read on the label of an over-the-counter drug?

INVESTIGATION 11-B

SKILL CHECK
- Initiating and Planning
- Performing and Recording
- Analyzing and Interpreting
- Communication and Teamwork

Over-the-Counter Drugs

Think About It

How do you choose among all of the over-the-counter medications available in the drugstore? Use this investigation to learn how to assess their advertising claims.

What to Do

1. Read the labels on three over-the-counter cold remedies.

2. Use a chart to record the following information about each product.
   - name
   - advertising claims (If these are not on the label, check ads for the product.)
   - ingredients
   - precautions and side effects

3. For each product, decide whether the ingredients list corresponds with the advertising claim. For example, if the package says using the product will suppress coughing, does it contain cough-suppressing ingredients? To help you answer this question, your teacher will provide you with a table that lists safe and effective ingredients found in cold remedies.

Analyze

1. **(a)** Which products, if any, have realistic claims? Assume that if a product has approved ingredients, the claim is realistic.

   (b) Which products, if any, make unrealistic claims?

2. **(a)** Which product(s) have you used?

   (b) How well did the product(s) work for you?

3. Why should precautions and side effects be listed on product labels?

Check Your Understanding

1. Should a doctor give you a prescription for an antibiotic if you have the flu? Explain why or why not.
2. Develop a one-minute speech explaining how to choose and take over-the-counter drugs.
3. **(a)** How do antibiotic-resistant bacteria develop? Use a sketch to help you answer.

   (b) Explain why this is a problem.

Key Terms

over-the-counter drugs

antibiotic

CHAPTER

11 Review

Key Terms

antibodies
physical defences
inflammatory response
immune system
macrophages
antigens
inherited immunity
acquired immunity
active immunity
passive immunity
vaccine
immunization
over-the-counter drugs
antibiotic

Reviewing Key Terms

If you need to review, the section numbers show where these terms were introduced.

1. In your notebook, write the correct term or terms to complete each of the following sentences.

(a) Your body recognizes substances called _____ that do not belong to it. (11.2)

(b) White blood cells that help defend the body from pathogens are called _____ . (11.1)

(c) Bacterial infections can be treated with _____ . (11.4)

(d) An injection of dead or weakened pathogens is called a _____ . (11.3)

(e) Tears are an example of _____ _____ . (11.1)

(f) Medications that are not prescribed by a doctor are called _____ (4 words). (11.4)

(g) To resist a disease such as measles your body produces _____ . (11.1)

(h) The immunity that passes from a mother to her child in breast milk is called _____ _____ . (11.2)

(i) The body's second line of defence against disease is called the _____ _____ . (11.1)

(j) Antibodies produced after a vaccination is an example of _____ _____ . (11.2)

(k) The group of defences that fight specific pathogens is called the _____ _____ . (11.1)

Understanding Key Ideas

Section numbers are provided if you need to review.

2. List and describe the features of five physical defences your body uses to protect itself from disease. (11.1)

3. Draw a sketch to help describe the role of white blood cells in an inflammatory response. (11.1)

4. How does your body recognize that a pathogen is invading? (11.2)

5. How do immunization programs help prevent the spread of disease? (11.3)

6. Identify the main contribution the following individuals made to our understanding of the human immune system. (11.3, 11.4)

(a) Edward Jenner

(b) Jonas Salk

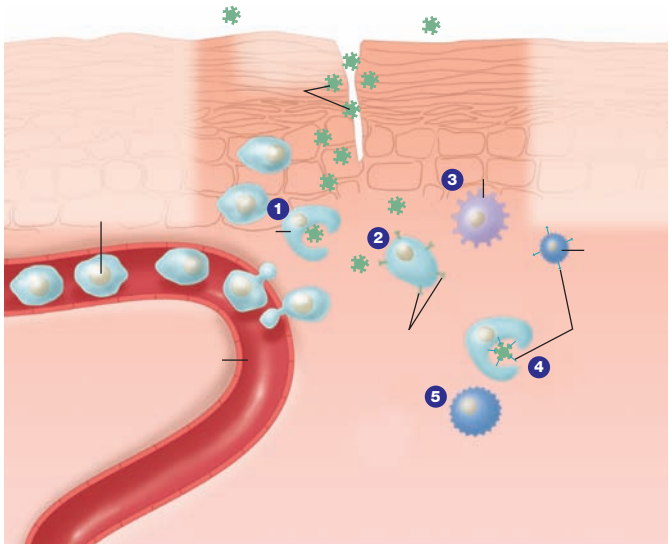
(c) Alexander Fleming

7. List three things that you should do when you get a prescription for an antibiotic from your doctor. (11.4)

Developing Skills

8. Draw a flowchart to identify and describe different types of immunity. Briefly explain each type. (11.2)

9. Briefly explain how the body responds to pathogens. Use the terms macrophages, helper T cells, B cells, and memory cells. Use the illustration below to help you. (11.2)



Problem Solving/Applying

10. Why might it be better to greet someone with a peck on the cheek or a hug than with a handshake? (11.1)

11. How might using antibacterial soaps lead to bacteria resistance? (11.4)

12. Why might a disease such as polio make a comeback even though there is a vaccine available? (11.3)

Critical Thinking

13. How does the acid on your skin protect you from disease? (11.1)

14. What advice might you give to someone about using adhesive bandages containing antibiotics for a minor cut? Provide a reason. (11.4)

Extend Your Understanding

15. Produce a poster that explains antibiotic resistance and personal actions you can take to help avoid it. (11.4)

16. Interview a health-care professional. Prepare a list of questions to ask about over-the-counter drugs. (11.4)

17. Use the library or the Internet to find out about the work of Albert Sabin. What contribution did he make to immunization? Present your findings orally. (11.3)

Pause & Reflect

1. Check your original answers to the Getting Ready questions on page 192. How has your thinking changed? How would you answer these questions now that you have investigated the topics in this chapter?
2. What practices are you prepared to adopt when you use antibiotics and over-the-counter drugs in the future?